Xtreme Xylanase: Enzyme discovery advances bioenergy processes

Yellowstone Park is a national treasure for more than its scenic beauty and wildlife. Life processes in its hot acidic pools may hold one of the keys to unlocking the value of biomass resources.

INL researchers are contributing a major advance in this effort through the most thermal and high-acid stable enzyme ever discovered. Isolated from a bacterium originally discovered in Yellowstone National Park, it is called Xtreme Xylanase. It is a superstar in efficiently converting hemicellulose and cellulose components of biomass into energy-rich sugars, a building block for fuels and high-value chemicals.

“Xtreme Xylanase is active under conditions like battery acid at 176 degrees Fahrenheit,” said INL scientist Vicki Thompson. “It is quite remarkable, and we were really surprised to see activity under those conditions.”

Biomass conversion involves three basic steps:

- pretreatment to convert biomass to component sugars;
- fermenting of resultant sugars using microorganisms, and
- processing fermented products into fuels or high-value chemicals.

What makes INL’s Xtreme Xylanase a true breakthrough technology?

It allows efficient, low-cost pre-treatments and fermentation because it is active at higher temperatures and lower pHs than are commercially available. This innovation opens the door for revolutionary advances in biomass conversion.

“Our Xtreme Xlyanase promises to eliminate high-temperature pretreatment steps, reduce time and cost, and streamline biorefinery processes in ways that will spur further process innovations,” said INL scientist Bill Apel. “The fact that this discovery eliminates the need for costly high pre-treatment temperatures and pressures involved in biomass conversion could truly be a starting point for a revolution in biomass processing.”

The xylanase discovery will have a profound impact on the biomass industry’s processing of agricultural residues and waste, forestry materials, urban waste and dedicated biomass crops.

Idaho National Laboratory

It also may have impact on processes in improving animal feed, producing foods from grain, increasing juice yields from fruits and vegetables, and many more. And, all of this will be done using an environmentally friendly enzyme.

“In fact, our discovery of the Xtreme Xylanase comes at a perfect time. It offers a major contribution to domestic energy production and security,” said INL researcher David Thompson. “Biomass technologies advanced by this discovery could enable the replacement of 60 billion gallons of gasoline, and the displacement of as much as 545 million tons of fossil fuel derived carbon dioxide emissions.”

“It is exciting to think that our Xylanase discovery could make a major contribution to the nation’s energy security and environmental stewardship,” said INL scientist Kastli Schaller.